The Study of Time IV

(Papers from the Fourth Conference of the International Society for the Study of Time, Alpach-Austria)

edited by J T Fraser, N Lawrence and D Park

Springer-Verlag : Berlin-Heidelberg-New York, 1981

286 pages, 26 figures ; price : US $ 45.70 (cloth)

This volume is the collection of papers presented at the Fourth Conference of the International Society for the study of Time (ISST). The object of the Society is to encourage the search for new knowledge about time and to learn about the nature of time from the interaction of the views from various desciplines. The papers dwell on two aspects—one the technology of time and the other the general concept of time.

The paper by Cairns-Smith on the mechanism of the origin of life on earth which may also be regarded as the origin of time, belongs to the first aspect. The theory is very interesting though it may not be acceptable to many. It envisages the origin of life to be the organic molecules linked up with clay materials which by selection and replication ultimately produced the genetic materials of to-day. In the evolutionary theory of life, the role of structure and symmetry of the organisms which form parts of the gene is discussed by Goodwin in another paper. The beginnings and end of time, i.e., the beginning and end of earth has been analysed by Park in the light of the observations of physical cosmology.

In the general theory of time aspect, the history of the gradual transformation of the concept of Subjective time (sequence of events) to the precise clock-time of to-day is developed from the studies of tragedies in literature by Macey. This contains a very nice and interesting analysis of a number of tragedies of different centuries. That beginnings and endings cannot be instantaneous but have continuity is the subject dealt with in another paper. The linear or cyclical dynamical change of time and the feeling of timelessness i.e. the sense of being outside of any time as experienced in meditation or trance is discussed with reference to music in a few papers. Hindu-Buddhist religious concepts of eternity or vastness of time and in which self has no place is compared with the music of some instruments in one of these papers. These papers on music seem to be somewhat technical to be appreciated by specialists. The volume is certainly a very good collection of information and analysis of conceptions in philosophy, literature, music and cosmology. The collection of papers in the book is highly interesting and thought provoking. It will certainly be useful to serious readers and is a worthy volume

to be kept in a Library. The paper, printing and the pictures are very nice and attractive.

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Nonlinear Phenomena in Physics (Springer Proceedings in Physics, Vol. 3)

Proceedings of the 1984 Latin American School of Physics, Sandiago, Chile, July 16–August 3, 1984)

edited by F Claro

Springer-Verlag : Berlin-Heidelberg-New York-Tokyo, 1984
441 pages, 110 figures : price : DM 98 (Hard cover)

The book under review records some of the recent developments in the area of nonlinear Physics which include astrophysics, gravitation, particle physics, quantum optics, fluids, mathematical physics of chaos and nonlinear waves. It represents a selection from lectures delivered at Latin American School of Physics held in Sandiago, Chile, in July-August, 1984.

The book begins with an account of dynamics of golden mean rotation which is very basic for understanding of breakdown of last KAM tori in deterministic stochastic dynamics. Particular emphasis has been given to trajectory scaling and power spectrum for quasi-periodic motion. Another article on a related nonlinear phenomena but in dissipative system deals with Rayleigh-Benard convection. Various concepts such as pattern formation, bifurcation theory in equilibrium, quasiperiodic and chaotic phenomena are introduced through it. A large part of the section on mathematical method discusses the statistical mechanics of Sine-Gordon field. The section ends with a short introduction to autonoma dynamics.

The second part of the book covers some nonlinear aspects of quantum optics from the experimental point of view. Quantum optics has proved to be a good testing ground for various nonlinear theories dealing with the problem of few degrees of freedom. The phenomena of optical bistability, multi-stability leading to chaos have been discussed at length, in two articles, with some unavoidable overlapping among them.

The part three is devoted to the recent developments in Rayleigh-Benard convection and interface dynamics with special reference to fluid-fluid interface and solid-liquid interface.

Some aspects of nonlinear problems in Stellar dynamics and general relativity have been discussed in Section four. The studies on the stability of motion of

planets pave the way for our major understanding of nonlinear dynamics, in general. Transition from ordered to stochastic motion in two and higher dimension has been treated in the first article while the others deal with solitons in general relativity and supergravity and nonlinear dynamics of space-time curvature.

The last section deals with simple grand unified models and quark-flavor mixing in standard model in high energy physics.

The articles are authoritative and in general, pedagogic in nature. The book is well-edited and needless to say, covers a wide spectrum. We are sure that this book will be a helpful addition in the field of nonlinear physics

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Spectroscopy of Molecular Excitons (Springer Series in Chemical Physics, Vol. 16)
V L Broude, E I Rashba and E F Sheka
Springer-Verlag : Berlin-Heidelberg-New York--Tokyo, 1985
271 Pages, 135 figures ; price : DM 148 (Hard cover)

The present volume deals with the development of the spectroscopy of molecular excitons. The spectroscopy of molecular crystals had long been connected most closely with the spectroscopy of molecules. Concepts of solid state physics entered the field much later. In solid state physics, the exciton concept of Frenkel went beyond the framework of Bloch's scheme. This concept was applied to molecular crystal by A. S. Davydov in 1948 which made a breakthrough in the analysis of rich spectra of molecular crystals which often contain more bands than that in free molecules. The 1957 paper of Craig and Hobbins on anthracene crystal generated a spurt of activity in the field. Molecular crystal spectroscopy has come a long way since then and a number of books have come out on molecular exciton spectroscopy in recent years.

In the introductory chapter of this book, the authors review the optical spectra of molecular crystals and deal with their basic classification.

In the following chapter, the basic principles of the theory of molecular excitons in a rigid lattice is formulated and the exciton theory is considered in terms of Green functions. Exciton disperson curves in a number of common aromatic crystals have been presented.

The present state of art of studying the exciton spectra of doped molecular

crystals is dealt with in the third chapter. A theory for the local excitons or impurity excitons is developed and it is shown that information on the structure of the exciton band of the pure crystals are obtainable from the analysis of the spectra of local excitons.

When the dopant component concentration is comparable with the host component, one gets, which is called, a mixed crystal. It then becomes impossible to discern isolated impurity centers and a completely different method of analysis is needed. Two approaches are (i) the average amplitude approximation and (ii) the coherent potential approximation. Exciton spectra of mixed crystals are treated in the fourth chapter. Also discussed in this chapter is the kinetics of excitons in mixed crystals in connection with percolation of singlet and triplet excitons. It is shown that Anderson localisation concept is useful to interpret the low temperature emission spectra of mixed crystals. Band to band transitions are special type of vibronic transitions whose initial and final states are band states ; one of the states contain an electronic exciton and the other contain an internal phonon. In chapter 5, such transitions have been treated and formulae which directly relate the shape of the optical spectra with the density of states have been derived. The reconstruction of the density of states from experimental data is demonstrated.

The concluding chapter deals with the vibronic spectra of molecular crystals. The shape of the exciton absorption band is determined by the exciton—molecular vibration interaction. It has been possible to develop detailed theory for the case when the half width of the exciton band is much less than the molecular vibrational frequency. The energy spectrum of the vibronic states in quantitatively described in the chapter for naphthalene crystal. The vibronic spectra of isotopically imperfect and mixed crystals of benzene and naphthalene are the subject matters of the concluding section of this chapter. The experimental data of these spectra is analysed in terms of vibronic spectra of the impurity centers.

In conclusion, this book deals with a large number of topics, some of them in great detail. There are, however, some gaps. The most obvious is the omission of molecular excition—lattice phonon coupling, an area of extensive current activity. The other omission that strikes the present reviewer is that the Indian contributions in the field have been ignored.

However, the authors are pioneers in the field of spectroscopy of molecular excitons and have contributed enormously in the development of the field. They have done a masterly job of organising information and communicating it in a most effective way. Every section starts with a brief introduction outlining the

objectives that bring new insight to the text. As such, this is an excellent reference book in molecular crystal spectroscopy.

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Landolt-Börnstein : Numerical Data and Functional Relationships in Science and Technology : New Series, Group II : Volume 13 : Radical Reactions Rates in Liquids : Subvolume e : Proton and Electron Transfer. Biradicals

by J K Dohrmann, J C Scaiano and S Steenken :
edited by H Fischer

Springer-Verlag : Berlin-Heidelberg-New York-Tokyo, 1985
386 pages ; price : DM 860 (Hard cover) , ISBN 3-540-13676-2

Following the practice of the Landolt-Börnstein series this 386-page volume consists of a set of neatly arranged informative Tables. The main subject is equilibrium and rate constants of established proton and electron transfer reactions. Each reaction is a spearate entry which contains information on the technique of radical generation, the method of rate determination and experimental conditions such as solvent and temperature.

The tables of this subvolume are divided into three sections : 9, 10 and 11. Section 9 contributed by Dohrmann is on 'Proton transfer reactions and equilibria of radicals' (142 pages). By radicals are meant organic radicals and literature coverage is for the period 1958-83 with 1984 in part. The data listed are pK values for proton dissociation of radicals, rate constant for proton transfer and related acid base reactions in protonic solvents. The radicals are classified as 'carbon-centered', 'nitrogen-centered', 'sulfur-centered', 'radicals from heterocyclic compounds' etc. Section 10 is compiled by Steenken and is entitled, 'Electron transfer equilibria involving radicals and radical ion in aqueous solution' (148 pages). Here rate and equilibrium constants for reversible one-electron transfer reactions in water between an organic radical or radical ion and a molecule (ion) to give a non-radical and a one-electron reduced or oxidised molecule (ion) are covered. Also covered are redox potentials for organic compounds in pure or mixed aqueous solutions. Section 11 titled 'Biradicals' (organic) is a contribution of Scaiano. Topics covered include unimolecular reactions of biradicals affording molecular products ; spin, acid-base and conformational equilibria of biradicals ; bimolecular reactions between biradicals and substrates ; quenching of excited states by biradicals (70 pages).

This valuable and painstakingly produced volume contains a wealth of information that will be useful to all dealing with reactions of organic radicals in one form or another—chemists, physicists, spectroscopists, electrochemists, biologists and others. It is a must for libraries of institutions interested in research on radicals.

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Landolt-Börnstein : Numerical Data and Functional Relationships in Science and Technology : New Series, Group II : Volume 17 : Magnetic Properties of Free Radicals : Subvolume a : Inorganic Radicals, Radical Ions and Radicals in Metal Complexes :

by C Daul, H Fischer, J R Morton, K F Preston, C W Schlapfer and A V Zelewsky

edited by H Fischer

Springer-Verlag : Berlin-Heidelberg-New York-London-Paris Tokyo, 1987
viii+507 pages ; price : DM 1280 (Hard cover) ; ISBN 3-540-16680-7

This volume is a supplement to previous compilations on magnetic properties of free radicals published earlier in the same series. The literature coverage is for the period 1975-1985. The first section on 'Inorganic radicals and radical ions' spreading over more than 190 pages in Tables and references is contributed by Morton and Preston. Here 'radicals' mean 'paramagnetic atoms, molecules or ions deriving their paramagnetism from a single unpaired *s* or *p* electron'. Transition metal ions deriving their paramagnetism from *d* electrons are generally not included. The word 'inorganic' is generally taken to mean, 'containing not more than one carbon atom'. In the Tables the radicals are arranged in the order of increasing atomic number of the geometrically central atom which may or may not hold the unpaired spin. The columns in the Tables correspond to : the free radical ; method of generation (often by irradiation) including matrix or solvent ; method of study (usually EPR) and temperature ; *g*-factor ; *a*-value ; references. The section start with muonium and ends with a neptunium-centered radical $[N_pF_6]^{\cdot}$. Many entries in this section involve oxo, halo and carbonyl species. The variety is for anyone to see. The second section covering more than 300 pages is entitled, "Radicals in metal complexes" and is compiled by V. Zelewsky, Daul and Schlapfer. Complexes with one unpaired electron localised on the ligands primarily constitute the subject matter of the Tables in this section in which the columns are the same as in section 1. Paramagnetic metal complexes with unpaired *d* or *f*

electrons are not covered. The information is presented according to groups of the periodic table. The number and variety of radicals produced by chemical/electrochemical/photochemical redox and in many instances by synthesis from stable components (e.g., attaching a spin label) is quite fascinating.

While section 1 will be of direct interest to radiation chemists, section 2 will be very welcome by the more conventional inorganic chemists. But the utility of this volume is not limited to these specialized areas. It will generally interest all involved in research on radicals in one form or another.

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Landolt-Börnstein : Numerical Data and Functional Relationships in Science and Technology : (New Series, Group II : Volume 17 : Magnetic Properties of Free Radicals : Subvolume b : Nonconjugated Carbon Radicals)
by F A Neugebauer,
edited by H Fischer
Springer-Verlag : Berlin-Heidelberg-New York-London-Paris Tokyo, 1987
vii+551 pages ; price : DM 1330 (Hard cover) ; ISBN : 3-540-16860-5

The literature covered in this volume pertains to the period 1975-1985 and like subvolume a it is a supplement and extension to the previously published volume 9. The layout of the Tables is the same as in subvolume a. The data on acyclic and cyclic alkyl radicals cover more than 480 pages. Vinyl, aryl, imidoyl, acyl and thioacyl radicals occupy less than 40 pages. This reflects where the action is in the area of nonconjugated carbon radicals.

This volume like its predecessors is a must for all interested in free radicals.

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The Atom-diatoms Potential Method : Applications to Organic Molecular Solids (Springer Series in Chemical Physics, Vol. 43)
by A J Perisin and A I Kitaigorodsky
Springer-Verlag : Berlin-Heidelberg-New York-London-Paris-Tokyo, 1987
ix+397 pages, 77 figures ; price : DM 140 (Hard cover)

This book covers one of the most widely used areas of solid state physics—the understanding and interpretation of the static and dynamic properties of organic molecular solids. The principal theme of the book is the use of atom-atom potentials for evaluating cohesive energies, equilibrium crystal structure, phonon spectra, thermodynamic parameters, crystal defects and aspects of polymorphic transitions. The first two chapters present fairly detailed and self-contained introduc tions to the theoretical background (mostly perturbative quantum mechanical models on a non-empirical level) and the atom-atom potential method. There is a comprehensive discussion on the various atom-atom potentials currently in vogue. The next two chapters discuss lattice-statics and lattice-dynamics in depth. Of particular importance are the treatment of concrete molecules such as benzene, naphthalene and some heteroaromatic systems. There is only a passing reference to the physics of the non-rigid molecules. This is a pity ; a much more detailed coverage of this fascinating and important subject would have been most welcome. The chapters on Thermodynamics and Imperfect crystals are well-written, but cover more conventional materials. Their importance lies in the detailed discussion of the actual computational processes, as for example, a thorough coverage of the evaluation of six-fold integrals involved in the computation of thermodynamic properties. The book will be real help to the researchers.

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Mathematical and Physical Aspects of Stochastic Mechanics (Lecture Notes in Physics, Vol. 281)
by Ph. Blanchard, Ph Combe and W Zheng
Springer-Verlag : Berlin-Heidelberg-New York-London-Paris-Tokyo, 1987
viii+171 pages , price : DM 34 (Hard cover)

The time-evolution pattern of a wide range of physical systems at the macroscopic and microscopic level can be obtained by introducing same random disturbance acting on the system during the evolution. A successful formulation of this

program involves characterisation of the kinetics of stochastic process as also the setting up of the corresponding dynamical law that specifies stochastic acceleration of a diffusion process (Nelson-Newton law). For global formulation it is imperative that one may characterise the dynamics of probabilistic systems by extremal properties of some non-linear functionals of the process (variational principle).

Starting from the study of Brownian motion to Feynmann path integrals, probabilistic aspects are observed to underlie much of classical and quantum physics. The conspicuous similarity between the Schrödinger equation and equations in the theory of diffusion processes had been noted by Schrödinger himself. Reinhold Furth (1933) formulated a stochastic analogue of the Heisenberg uncertainty relation. The first serious attempt to interpret quantum mechanics as a theory of Markov process in configuration space was made by Imre Feynes in Hungary. Since then the elucidation of various aspects of stochastic processes, Schrödinger equation and Feynmann path integrals as also their interrelations became the subject of intensive study all over the world resulting in a body of knowledge which has acquired an independent status termed "Stochastic Mechanics". This program outlined above for the evolving subject of "Stochastic Mechanics" forms the theme of the volume under consideration.

The authors give a good exposition of the subject covering both classical and quantum phenomena. Through the seven chapters in the book, the reader is taken on a step-by-step tour of the evolution of the application of probability concepts in the dynamics of complex systems. Such a wide but concise coverage of various aspects of the theoretical formulations of stochastic processes occurring at the macro and micro level is seldom available in a single volume. Furthermore, the book gives outlines of a number of current ideas and applications of the subject – such as trapping phenomena and formation of spatial patterns, transport in plasma, jet streams in the proto-solar Nebula etc. The discussion on many topics could be used as a launching ground for further study. A good literature reference is provided at the end.

Some minor misprints occur here and there in the book. For example, on page 61 reference to equation (2.57) should be (2.60). One would have liked to see the works of Gilson (1968) on stochastic aspects of quantum mechanics and that of Rylov (1971) on quantum mechanics as a relativistic Brownian motion included in the volume. It is a good book both for the research student as also as a desk reference for the seasoned researcher in the field.

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Theoretical Physics on the Personal Computer

by E W Schmid, G Spitz and W Lösch (Translated from German by A H Armstrong)

Springer-Verlag : Berlin-Heidelberg-New York-London-Paris-Tokyo-Hong Kong, 1988
xii+211 pages, 152 figures ; price : DM 79 (Hard cover)

With the arrival of powerful personal computers (PC) in mid-eighties, PC has become a very useful tool in theoretical physics education and research due to its high computational performance and interactive capabilities with rapid graphical output of the results. In this regard, the book is welcome to both the fresh and advanced research workers in theoretical physics as well as theoretical chemistry.

The book is divided into 19 chapters with an introduction on the programming of the numerical portions of the programs and of the input and output in chapter 1. Chapters 2-3 concern with numerical differentiation and integration with introduction into screen dialogue. Other chapters 3-19 are concerned with physical problems covering the fields of classical mechanics, wave physics, electrodynamics, thermodynamics and quantum mechanics. Each chapter (Chaps. 2-19) is nicely divided into 5 sections, viz., formulation of the problem, mathematical/numerical methods, programming, exercises and solutions to the exercises (with graphics output). Every chapter is limited to a few lucid pages without any unnecessary details. The problems considered in the 16 instructive chapters (Chaps. 4-19) are very interesting and educative. The programs (written in Fortran 77) in chapters 2-19 are excellent and can also be used on the mainframe computers of recent generation. The optimised version of the piece of program (for Simpson rule) in chapter 1 is quite illuminating. All the main programs (in Fortran 77) are stored in the floppy disk supplied with the book. The references given at the end of the book are very useful.

A few words may be said to improve the next addition of the book. In chapter 13, the Fox-Goodwin method is more well known as the Numerov (Neumerov !) method. The often used term 'numerical display' (viz., Chap. 13, Sec. 5) for graphical output is quite confusing. It should be termed as graphical display. It may also be mentioned that all the tabular forms displaying the programs/notations etc. have been termed as figures. It is better to term those as tables.

The English translation of the book by A. H. Armstrong from the original German edition is praiseworthy. This book is certainly a valuable gift to the research workers in the fields of theoretical physics/chemistry.

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